



Long-Term Trends in Channel Response and Stream Temperature in Redwood Creek

Vicki Ozaki

Redwood National Park

Legacy of Intensive Land Use





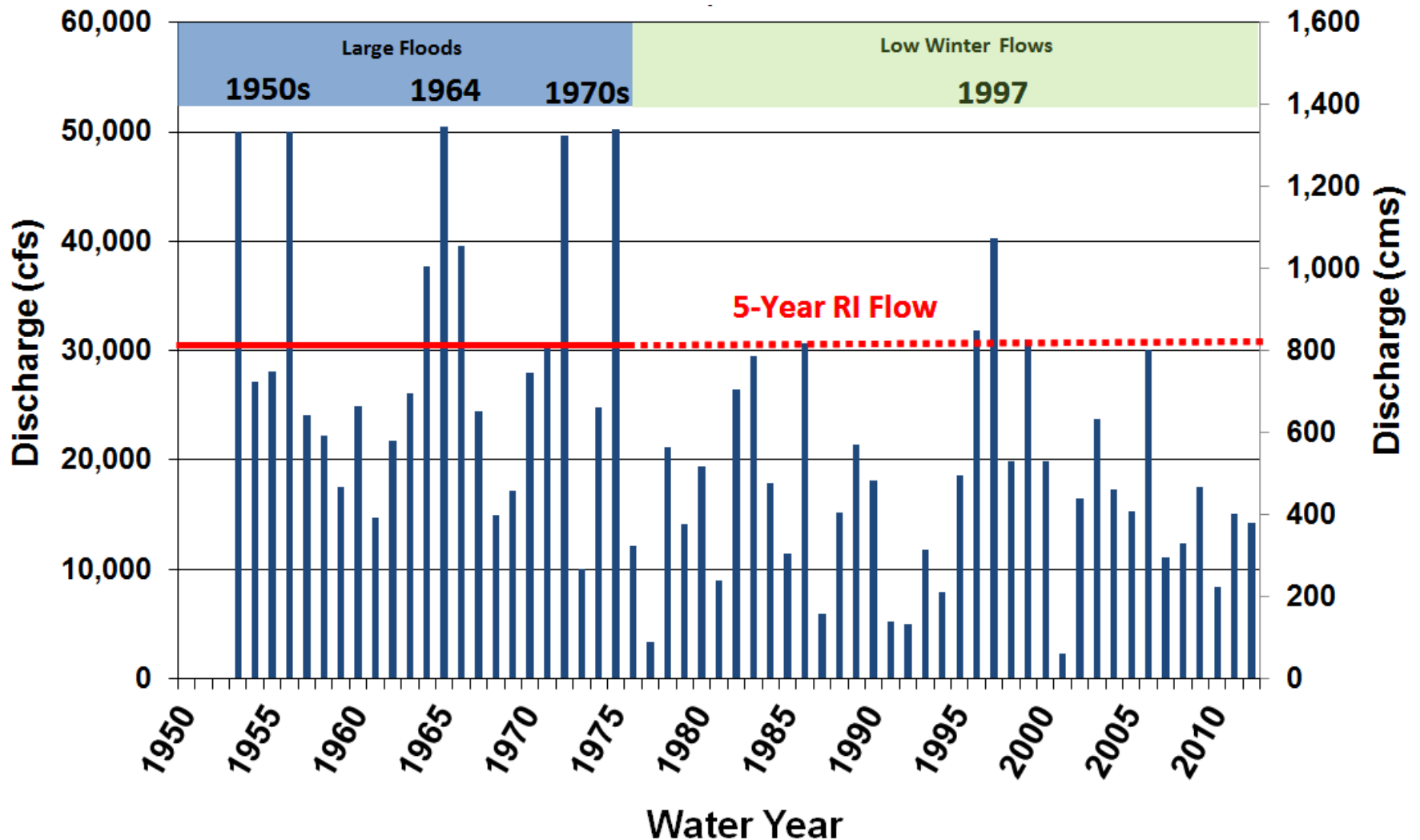
Bridge Creek

Large Floods



Flood History

Redwood Creek at Orick, California



Redwood Creek

Clean Water Act (303d List) -

- Sediment Impaired
- Temperature Impaired


Endangered Species Act –

- 3 out of 4 salmonid species listed as Threatened (Coho and Chinook salmon, Steelhead trout)



Key Monitoring Programs

Tiered to watershed listings

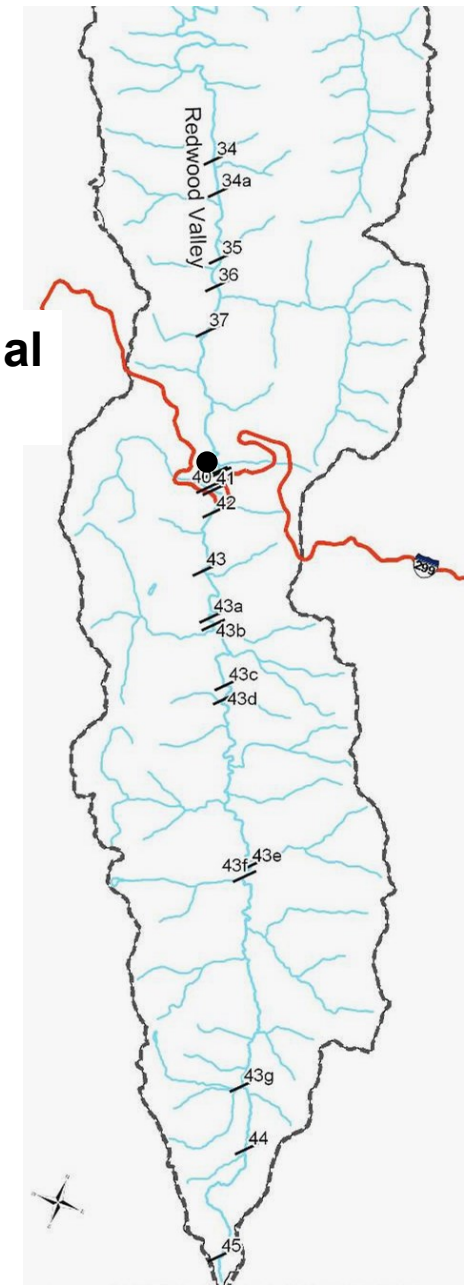
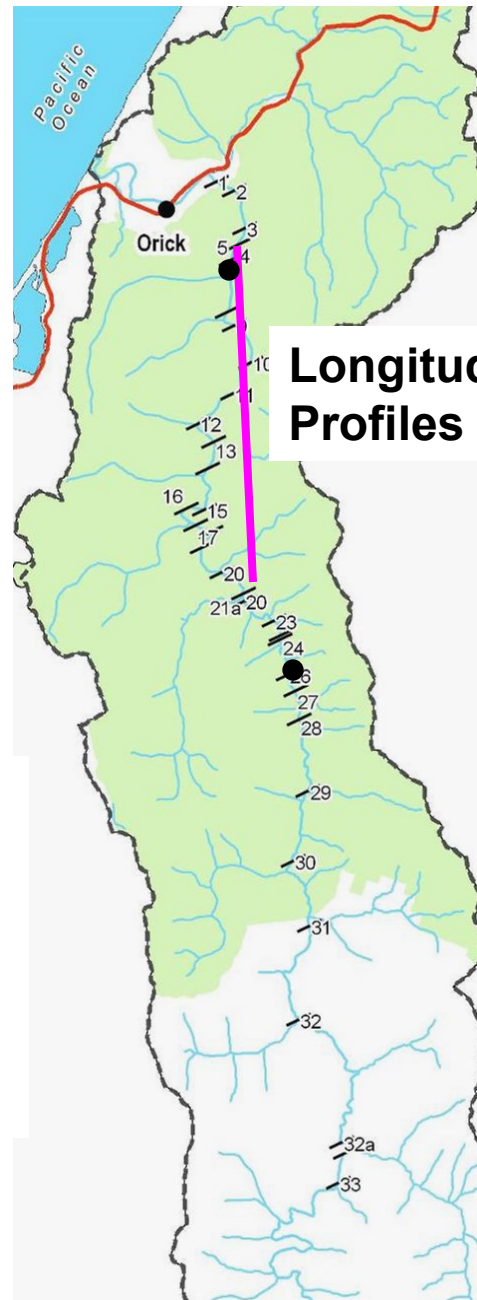
- 
- An aerial photograph of a coastal watershed. A river flows from the inland, hilly area towards the ocean. The river's path is visible as a light-colored line winding through green fields and brownish hills. The river meets the ocean, creating a wide, sandy beach and a large, shallow, light-colored area of sediment transport. The ocean is dark blue, and the sky is overcast.
- Channel response studies
 - Sediment transport
 - Stream temperature monitoring

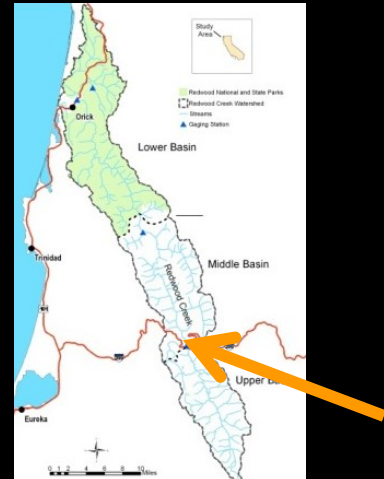
Redwood Creek Channel Monitoring

*Evaluate long-term channel
response and trends*

40 years

- **Cross Sections**
- **Longitudinal Profiles**

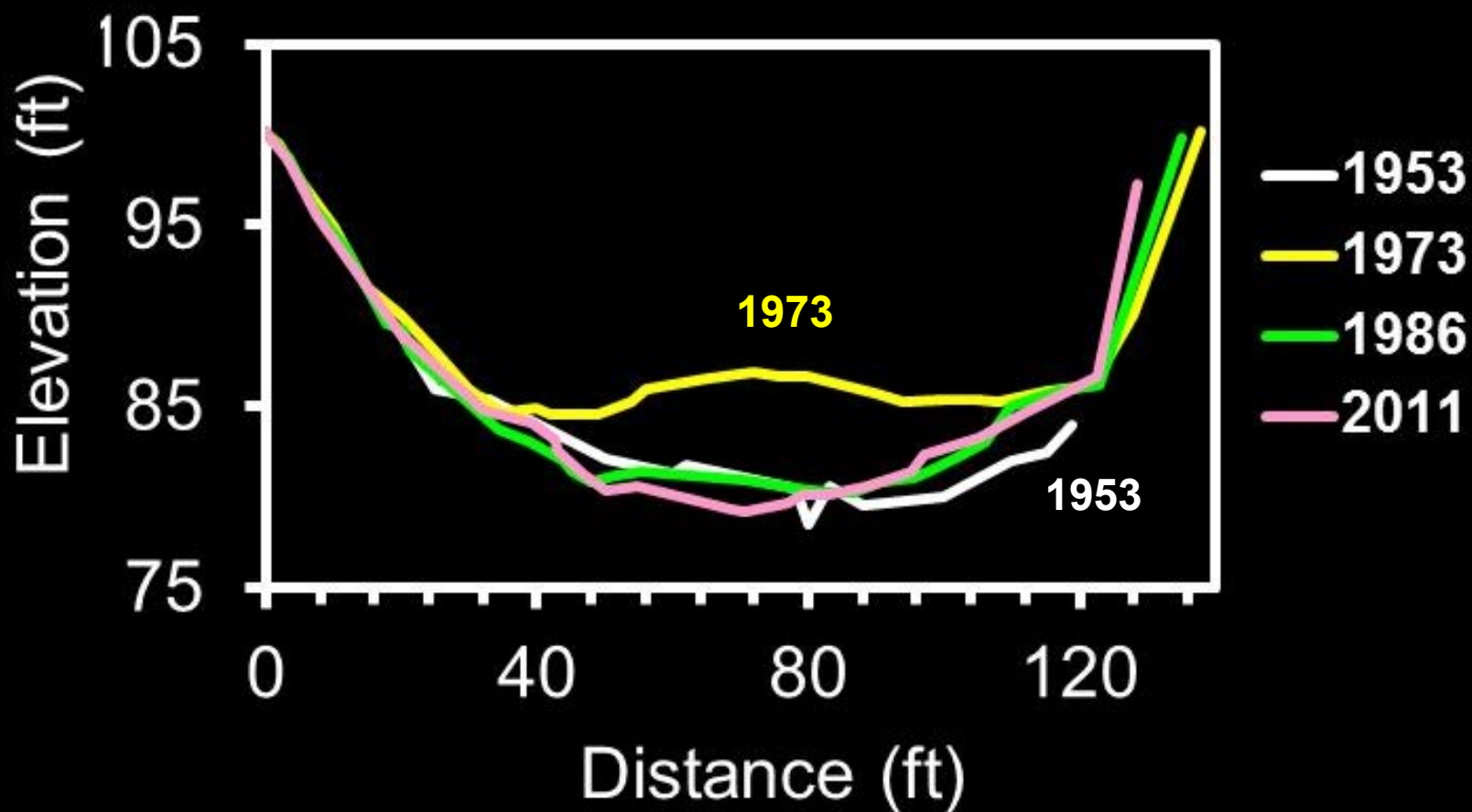




Upper Basin

Cross Section 40

(below HWY 299)



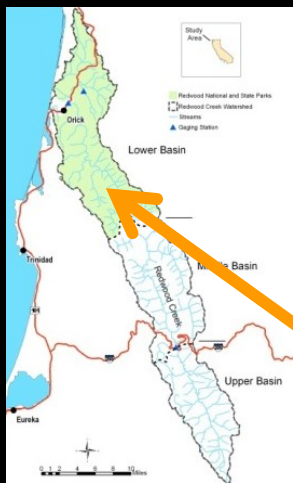
Redwood Creek at O'Kane Gaging Station



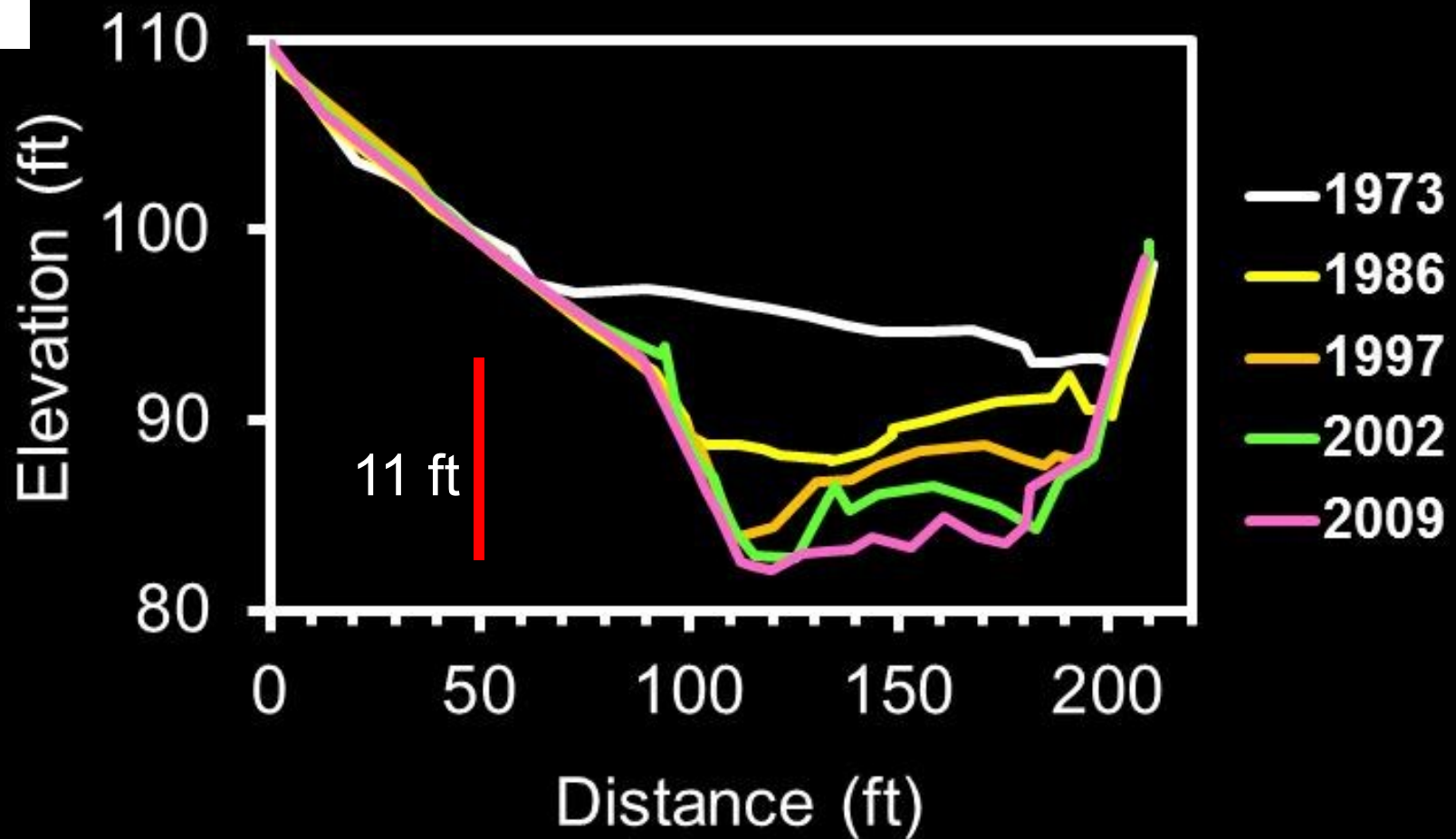
1985

Redwood Creek at O'Kane Gaging Station



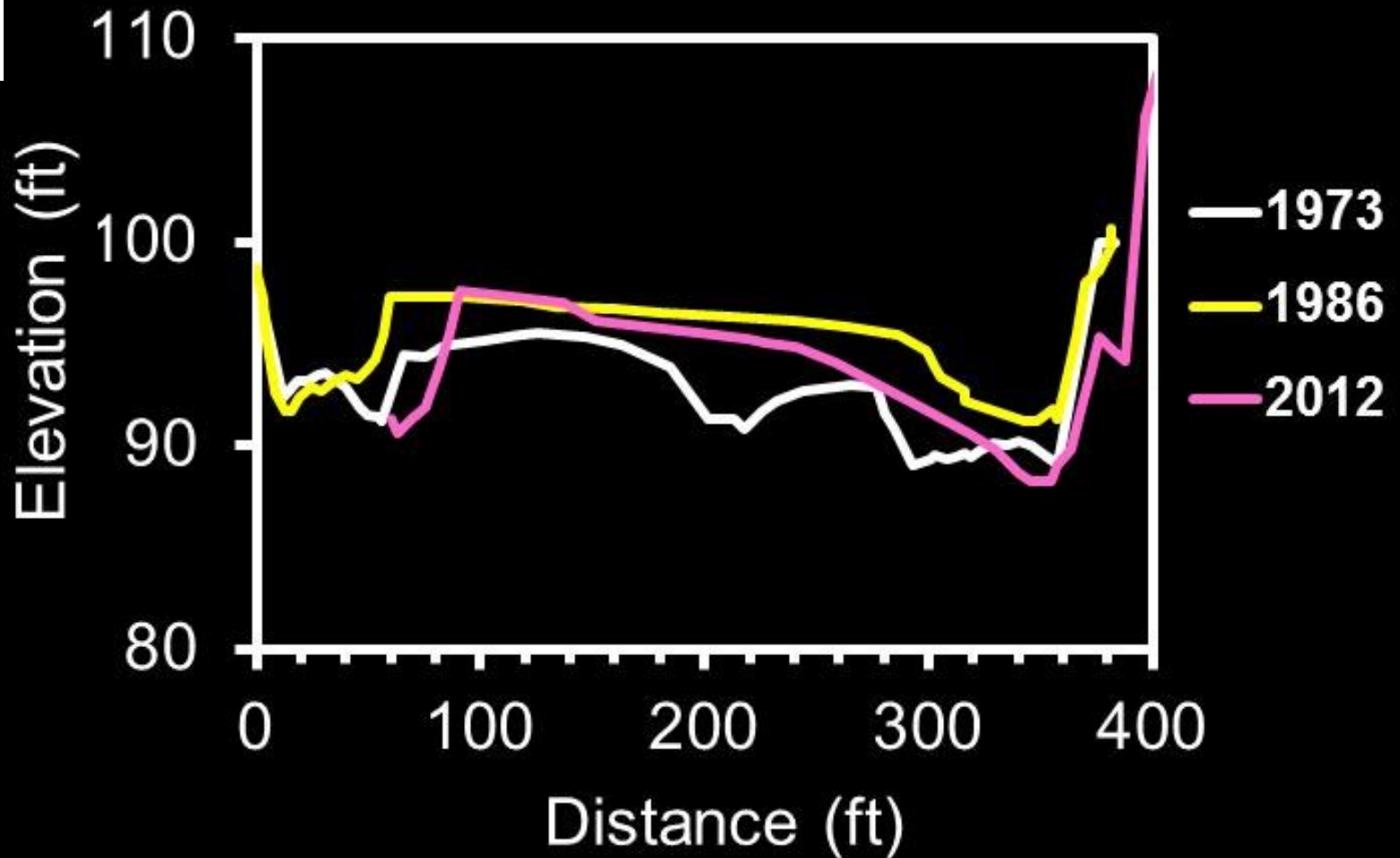


Cross Section 25 (below the Gorge)





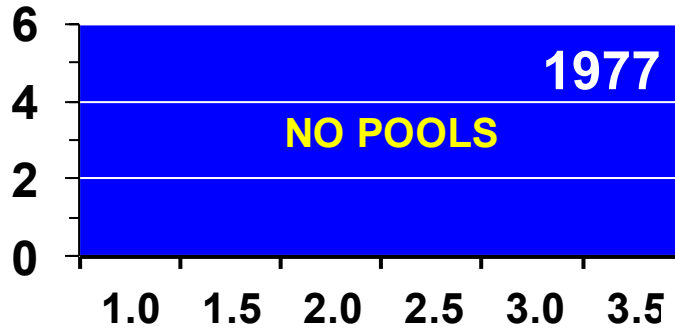
Cross Section 6 (below Elam Creek)



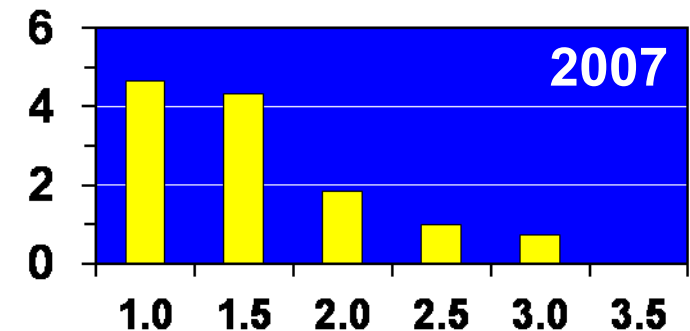
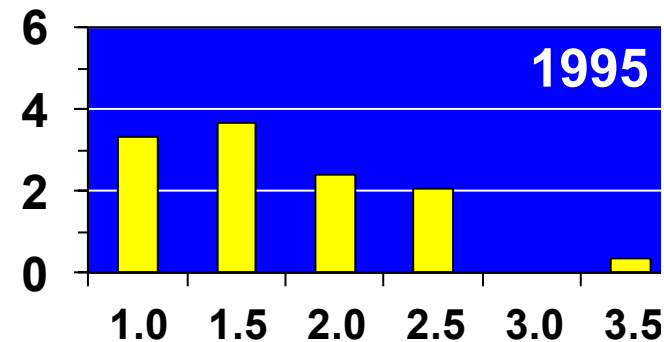
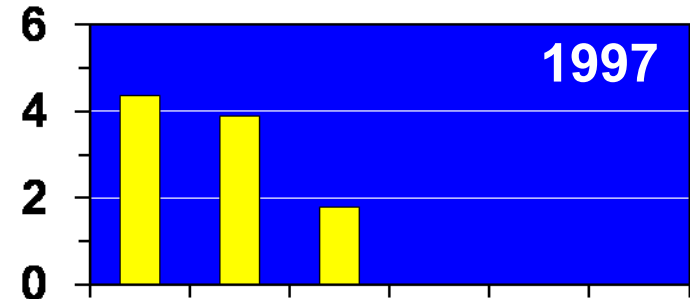
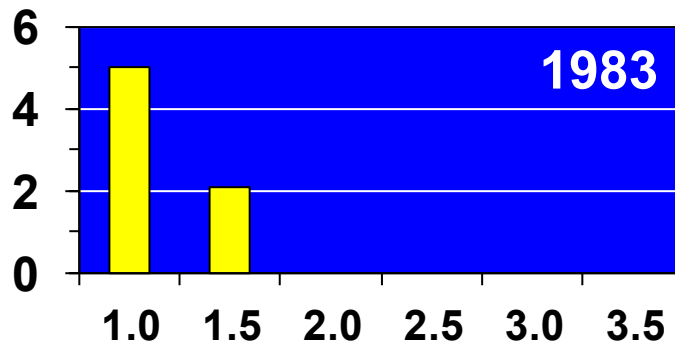
Change in Pool Distribution

Lower Redwood Creek

Pools
per Km



1997 Flood
10 year RI

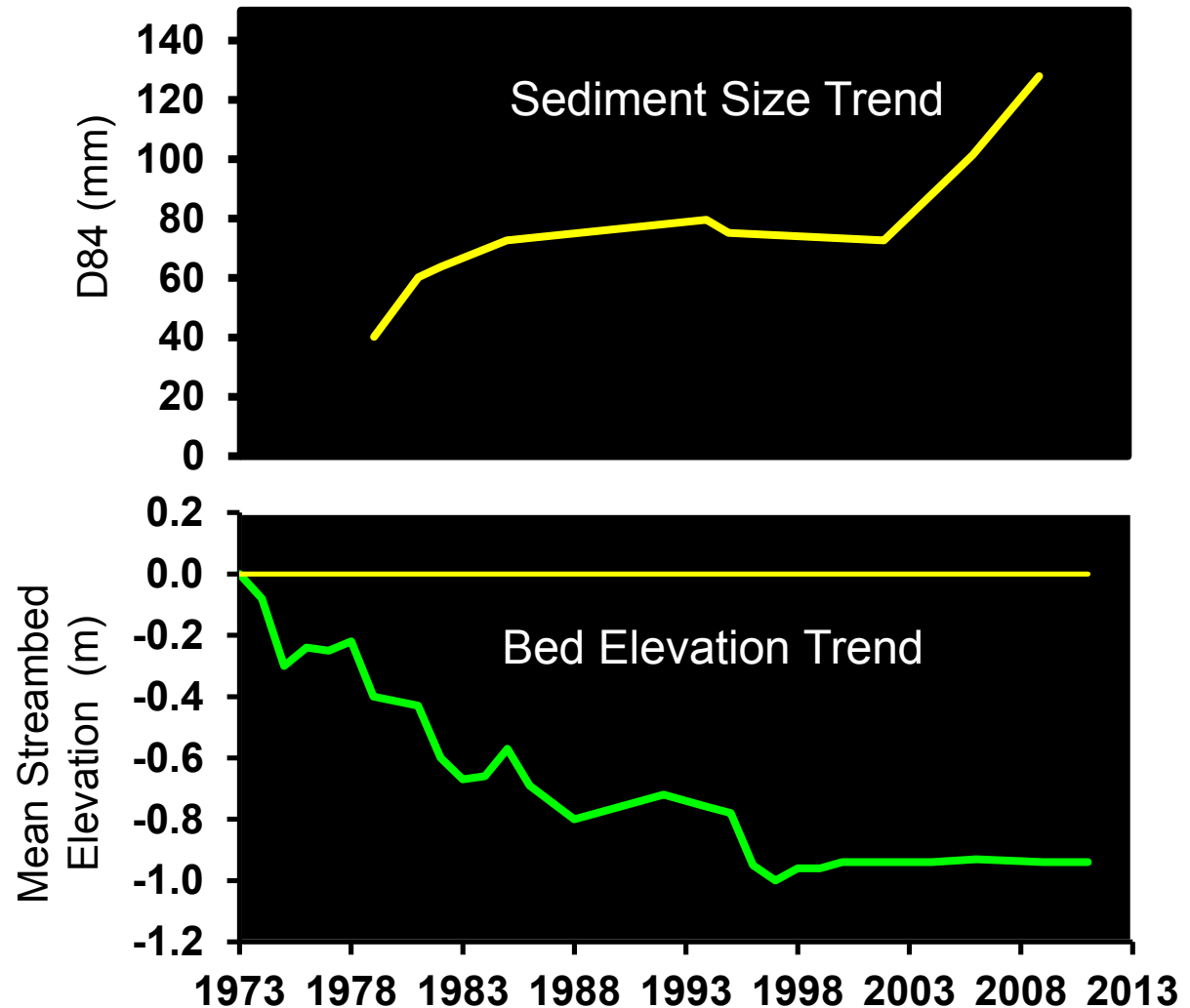


Residual Pool Depth (m)

Residual Pool Depth (m)

Response in Sediment Size to Channel Change

Middle
Basin

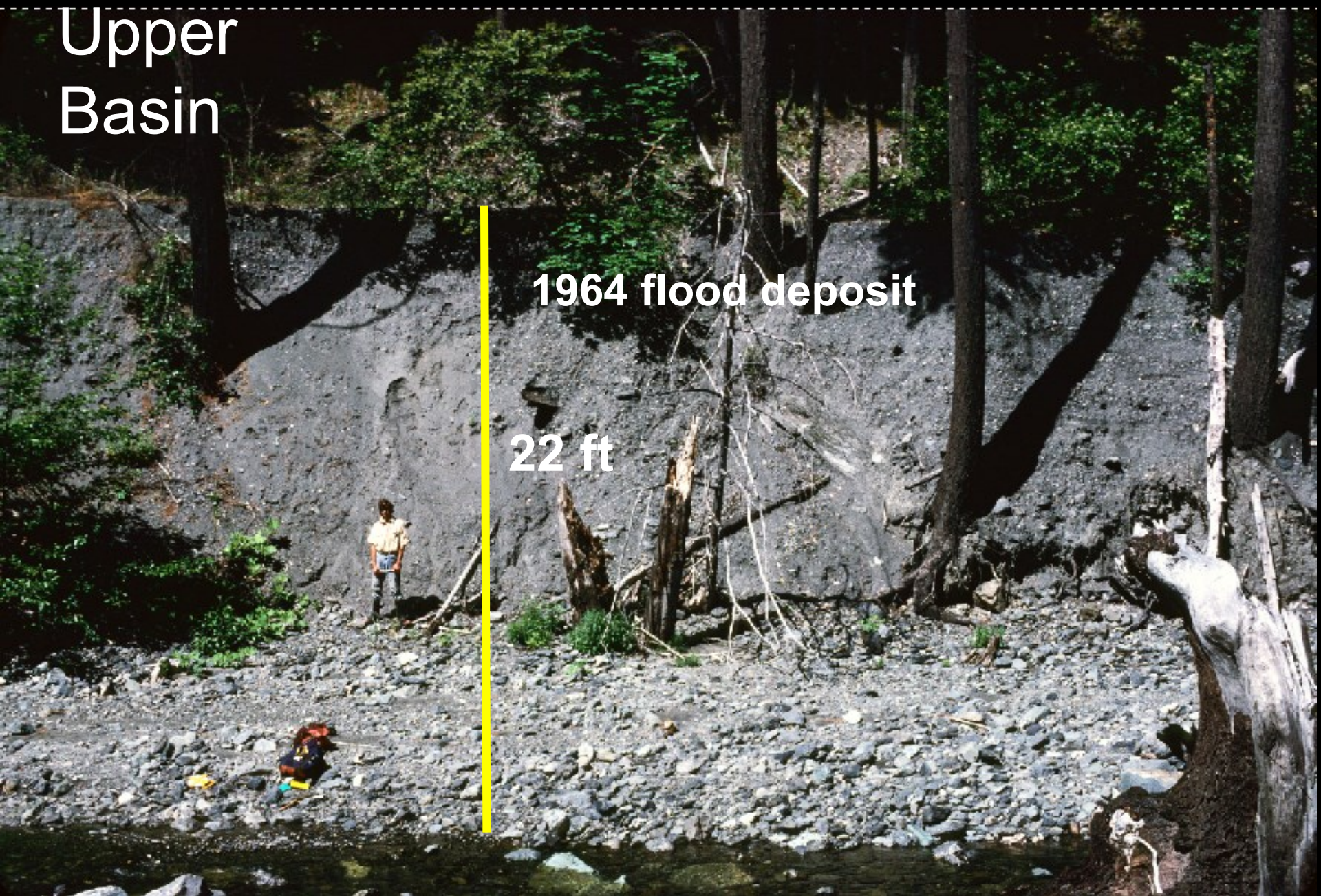




Upper Basin

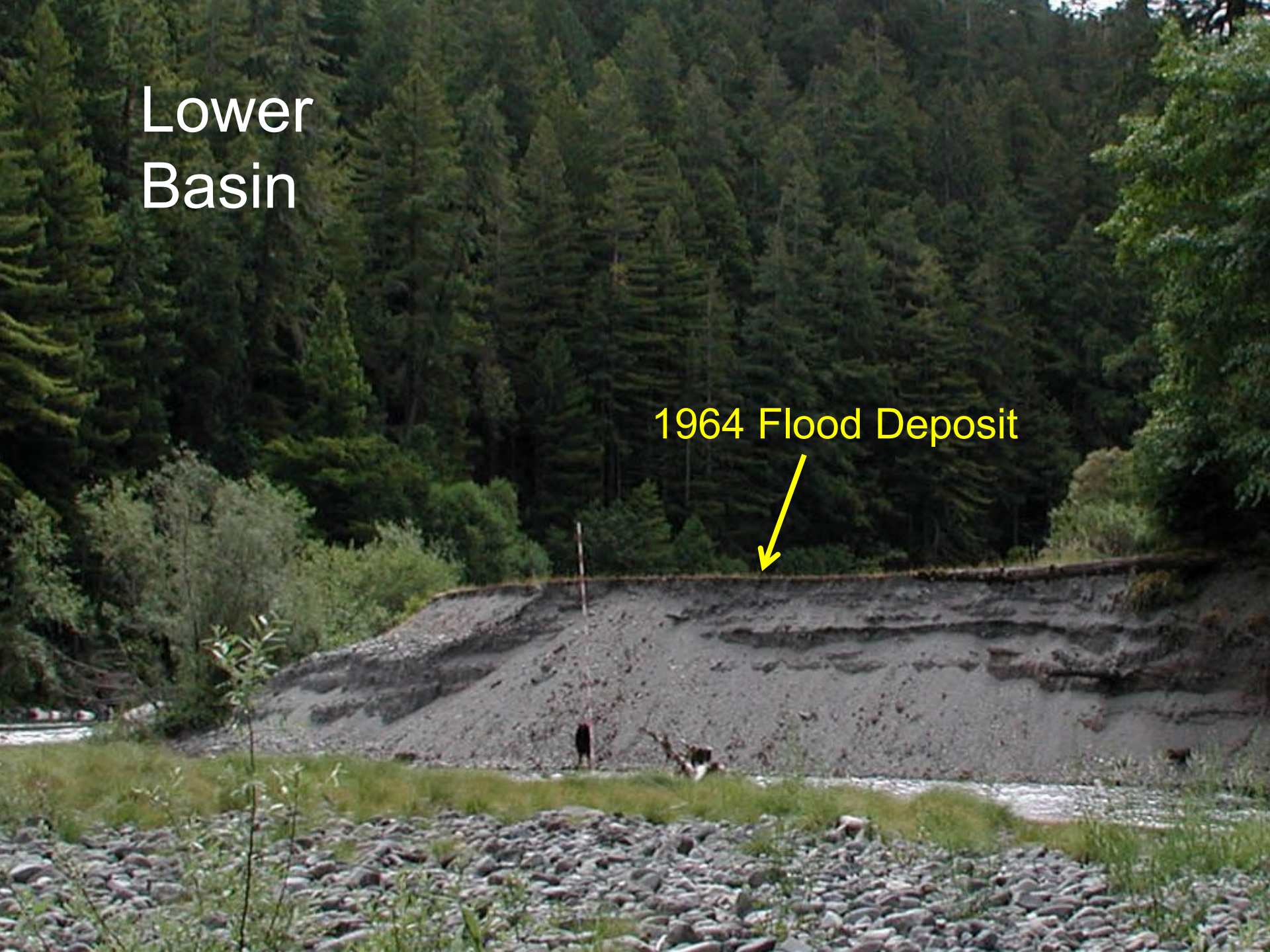
1964 flood deposit

22 ft



Lower
Basin

1964 Flood Deposit



Lower
Basin

20 ft

A photograph of a riverbed with a yellow dashed line and a vertical scale bar indicating a 20-foot depth. The riverbed is composed of grey sand and gravel, with a person standing in the water for scale. The background is a dense forest of evergreen trees. The foreground is a rocky, gravelly area with some green vegetation. A yellow dashed line runs horizontally across the middle of the image, and a yellow vertical line runs from the dashed line down to the riverbed, with the text "20 ft" next to it.

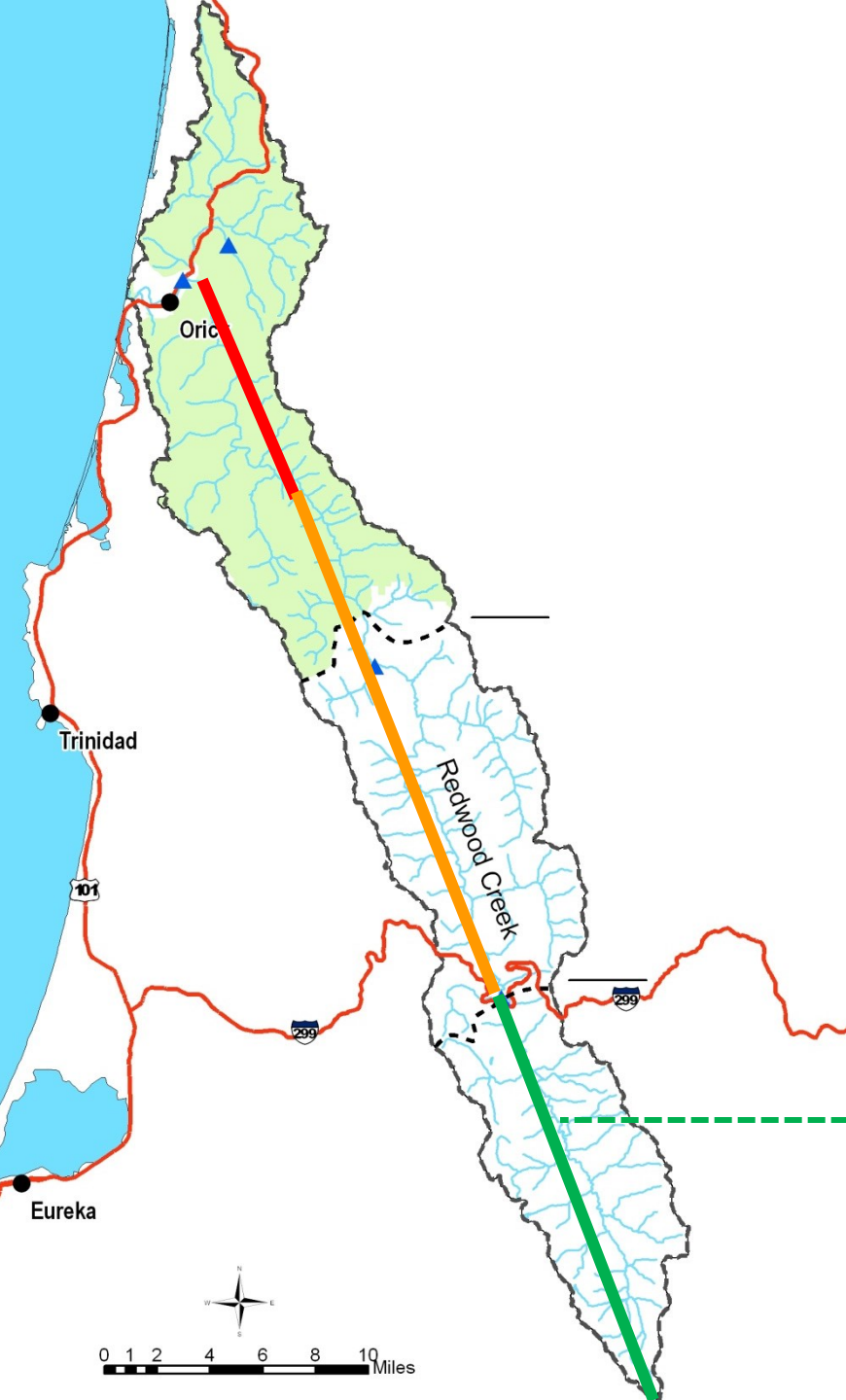
A scenic view of a rocky coastline. A large, moss-covered rock sits in the water on the left. A fallen log lies horizontally across the upper left. The background is a dense forest of green trees. On the right, a sandy beach is visible with two people standing near the water's edge. The water is calm and reflects the surrounding greenery.

Island Rock



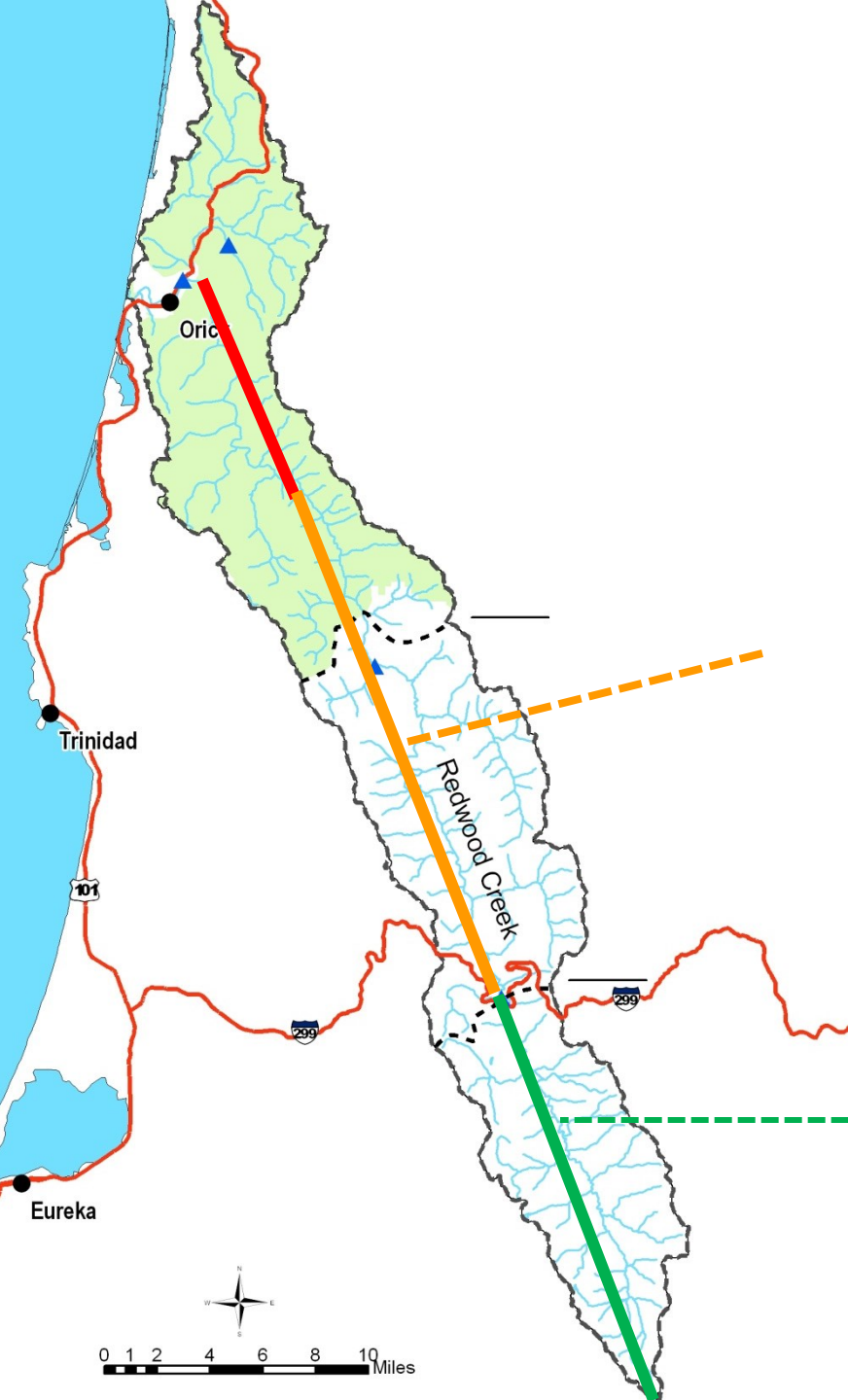
Island Rock

20 ft



Upper Basin:

- Reached stable bed elevation
- Strongly Armored
- Bedrock exposed



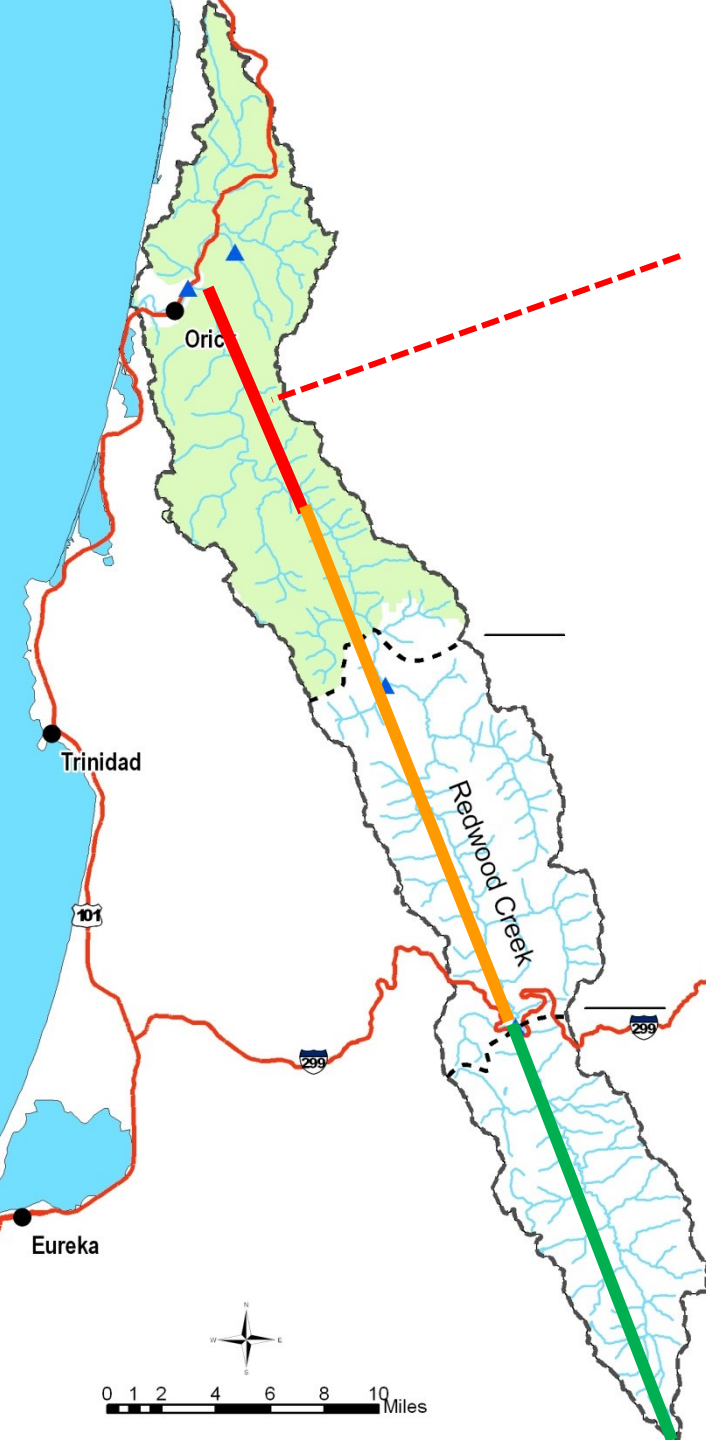
Middle Basin:

Channel scouring or reached
stable bed elevation

Upper Basin:

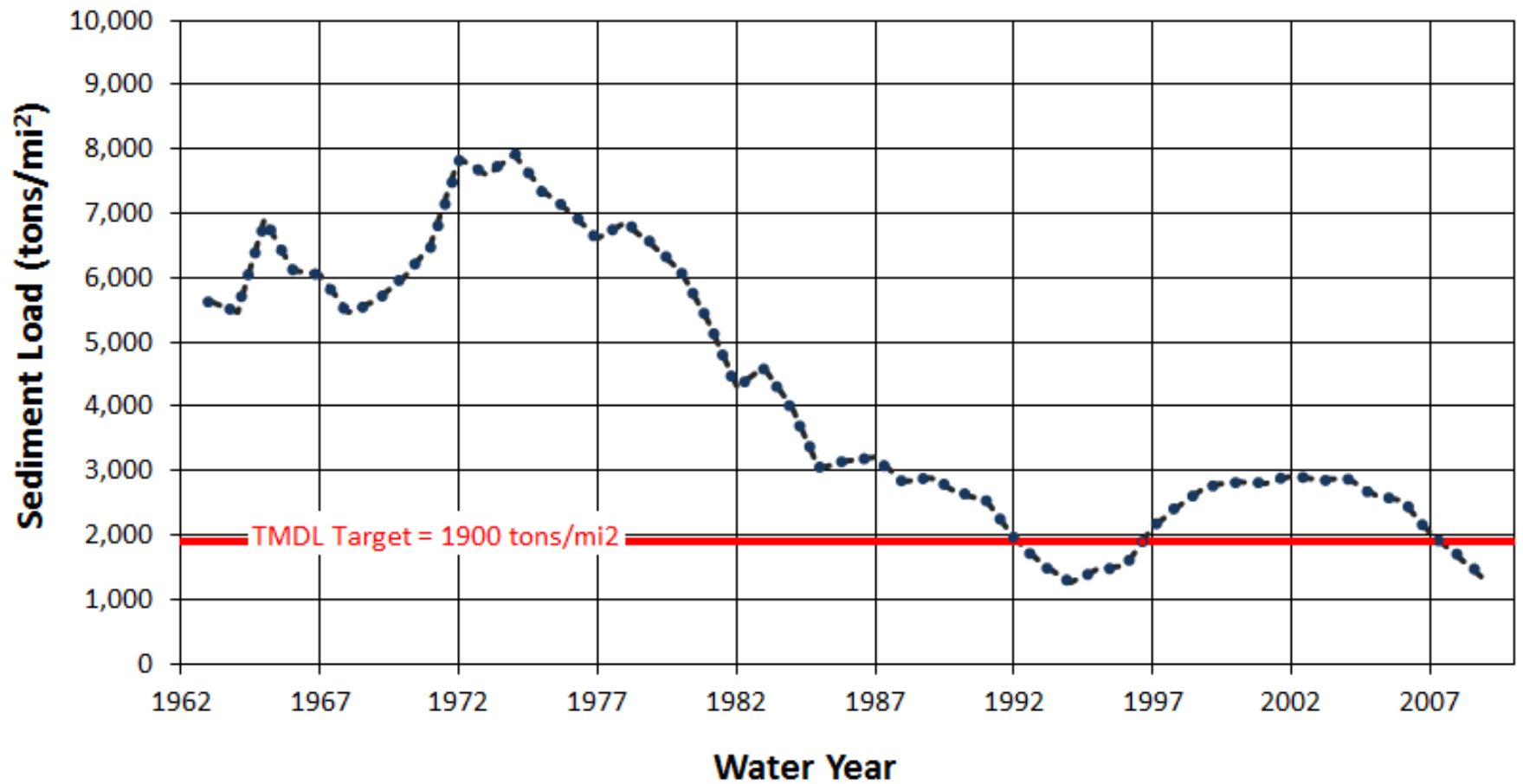
- Reached stable bed elevation
- Strongly Armored
- Bedrock exposed

Lower Basin: Sediment Impacted Reach



Redwood Creek at Orick Sediment Loads

10-year rolling average 1963-2009



Lessons Learned

- Redwood Creek recovery trajectory, but small floods set back recovery.
- Decades to flush sediment out of the lower river.
- Resiliency and the Next Flood?

Redwood Creek Stream Temperature Monitoring

Juvenile coho and steelhead:

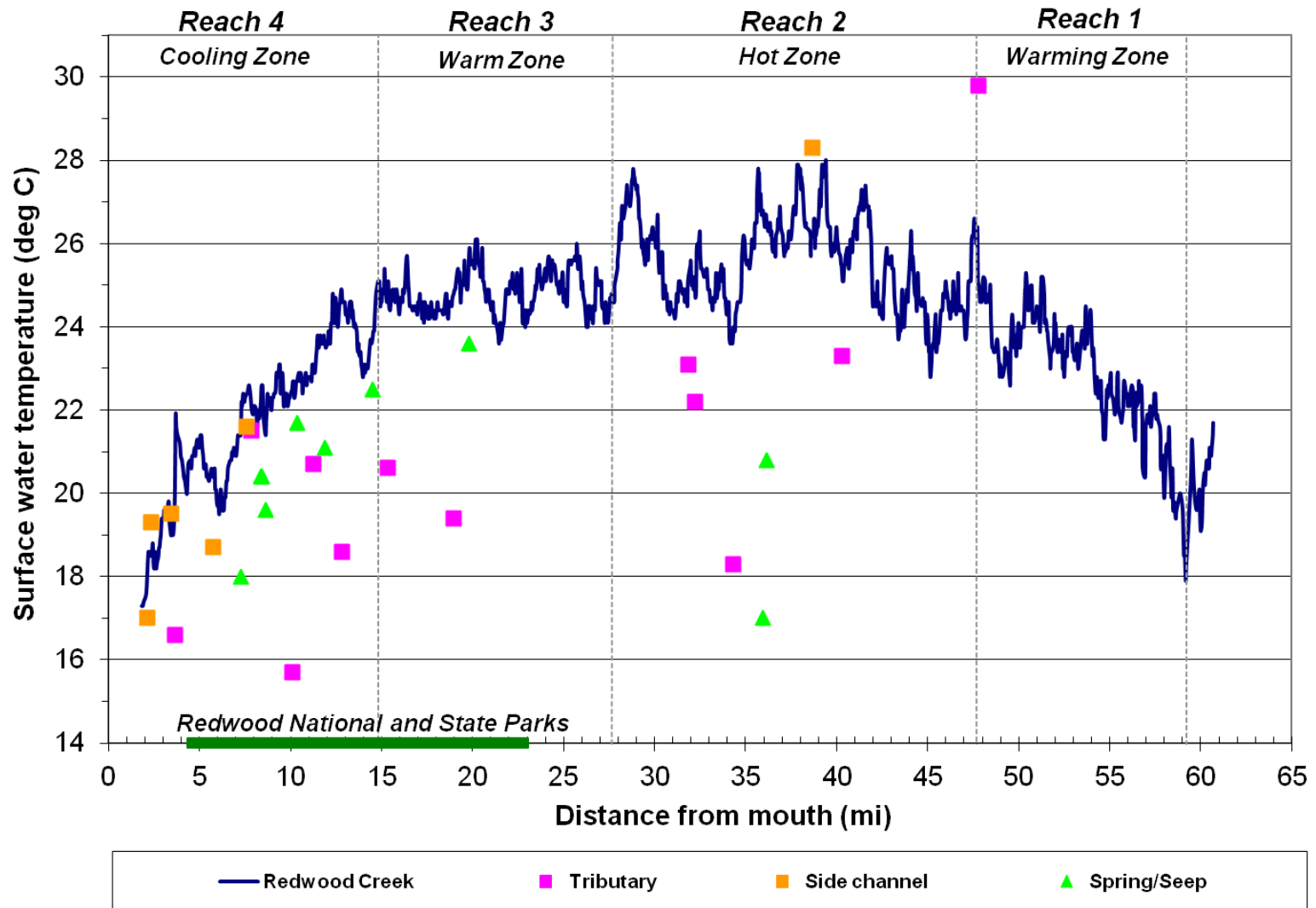


- Reside in stream at least 1 year.
- Prefer 12-14°C - avoid temp > 15°C
- About 18-20°C growth stops/slows down
- Extended exposure above 25°C may be lethal
- Require cool water during summer.

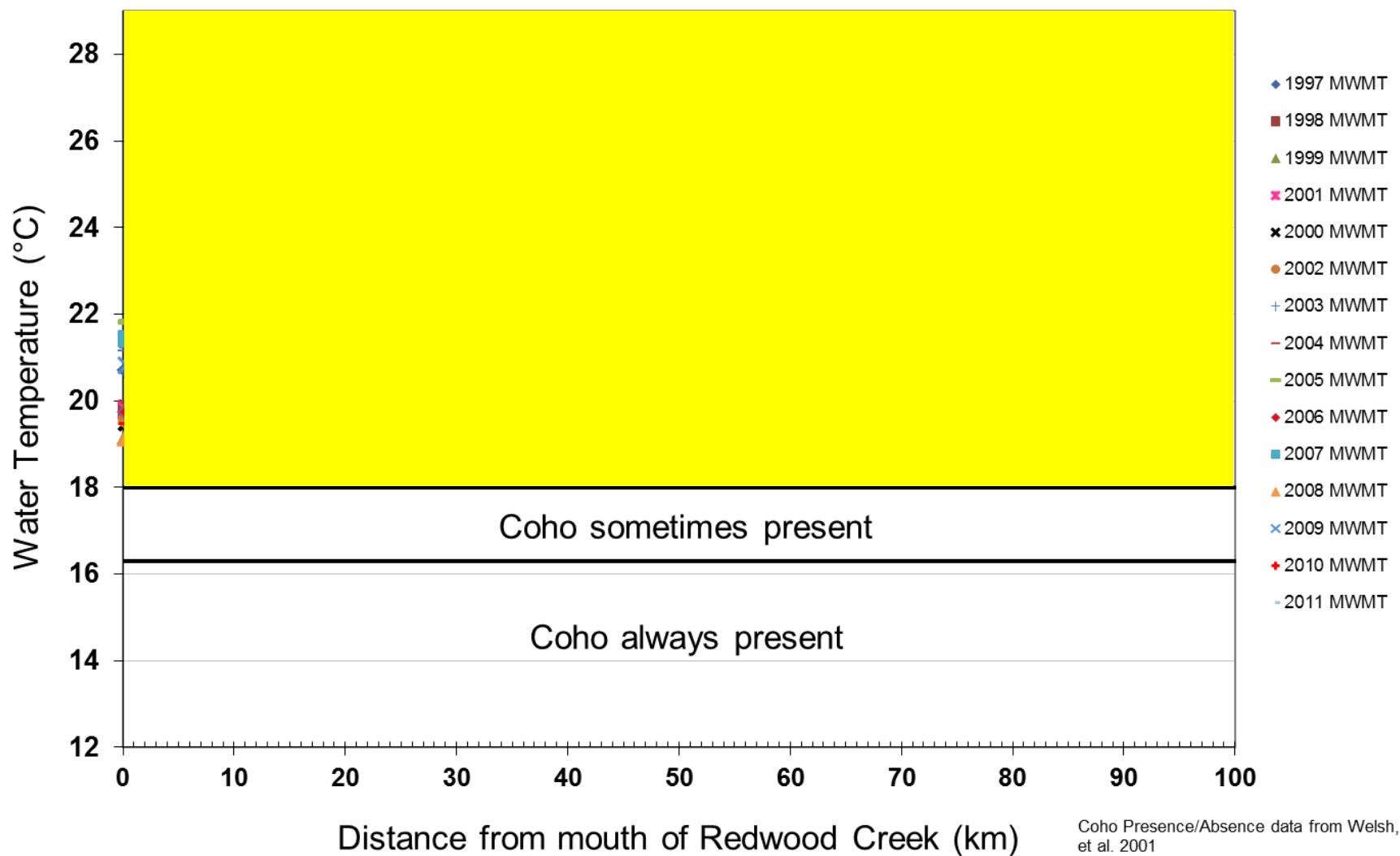
Stream Temperature Monitoring

- Ground-based measurements
(in-stream data loggers)
- Remote sensing technique (thermal infrared imaging)

Redwood Creek

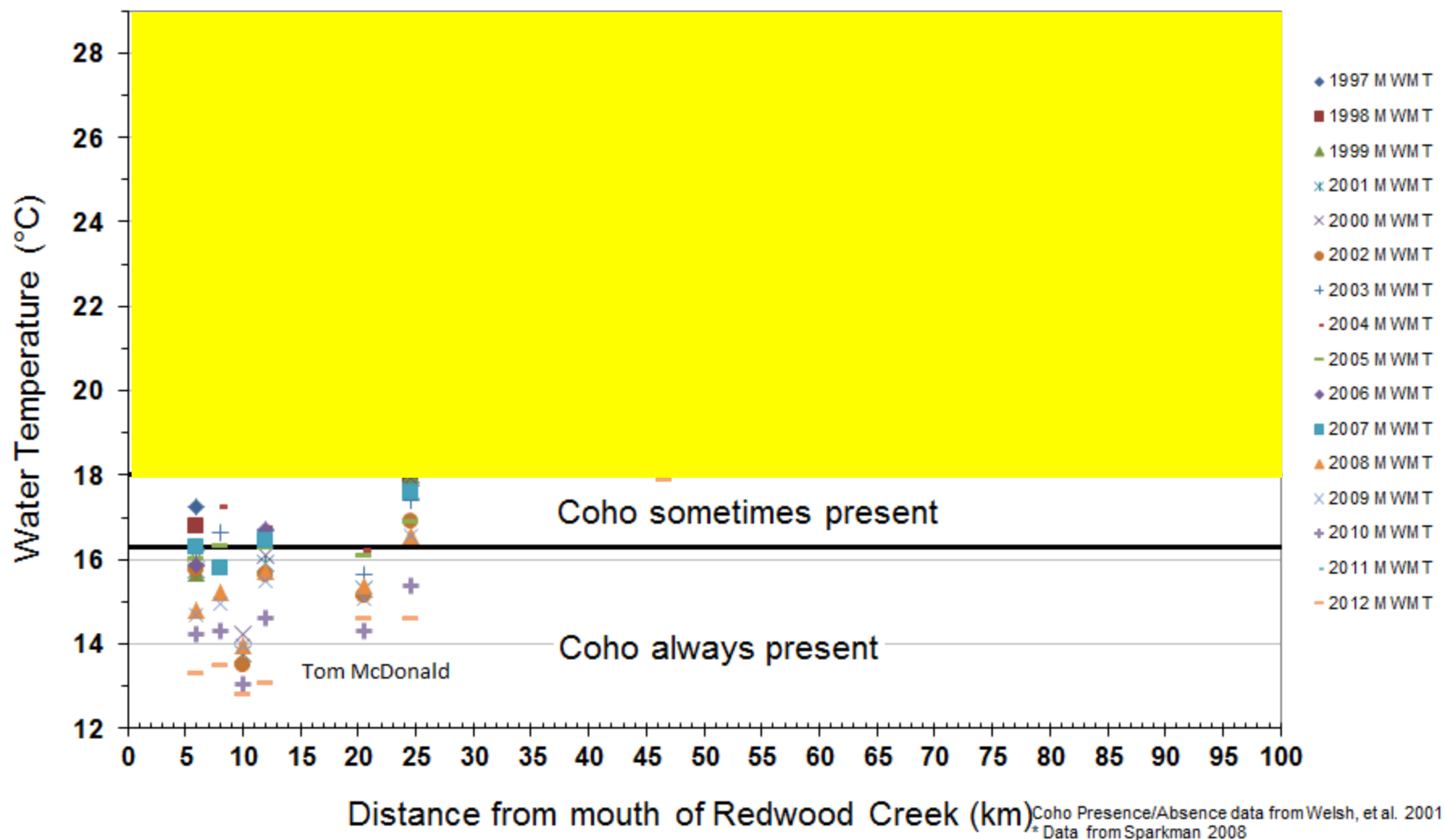


Maximum Weekly Maximum Temperatures (MWMT) Redwood Creek

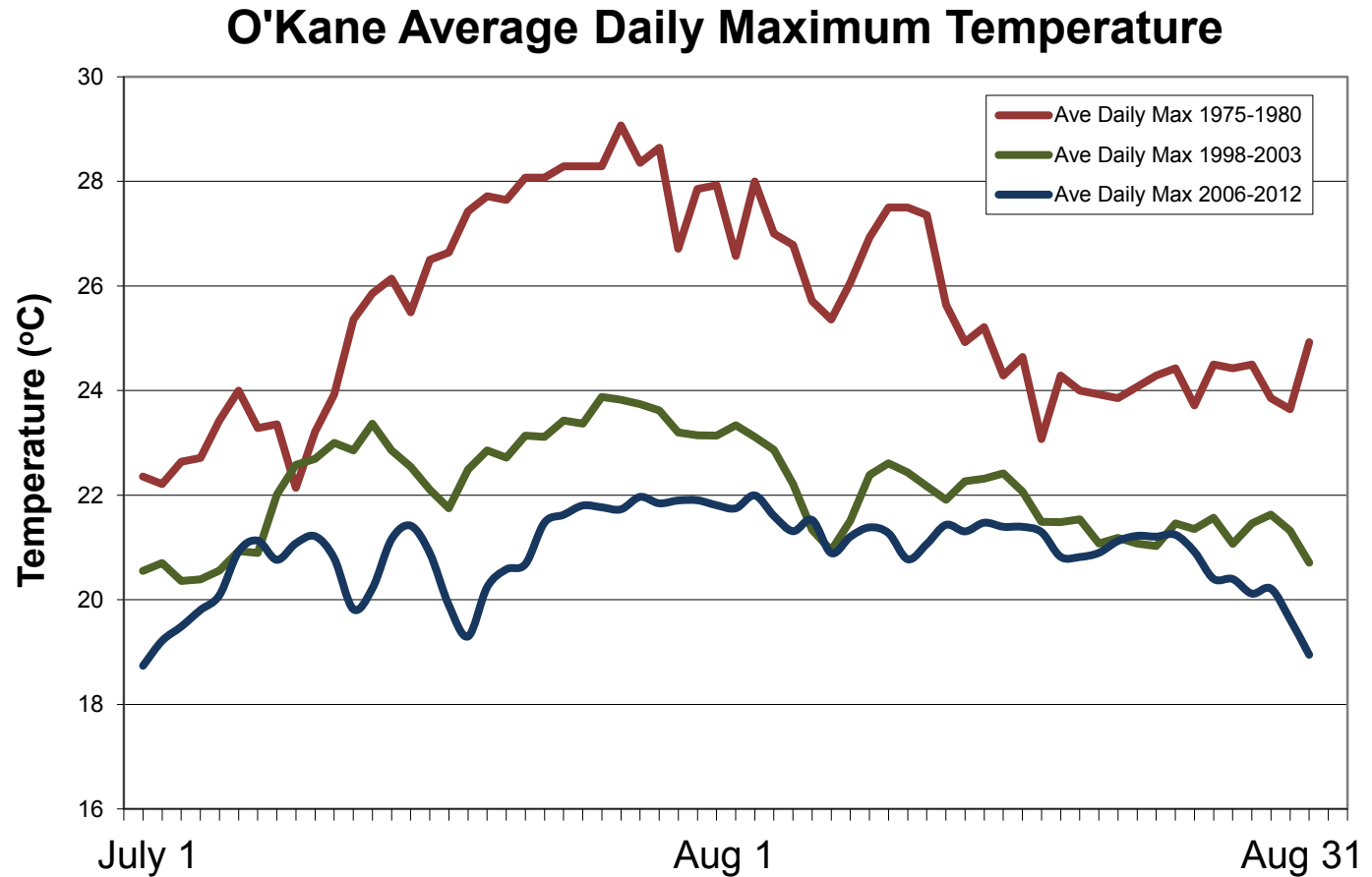
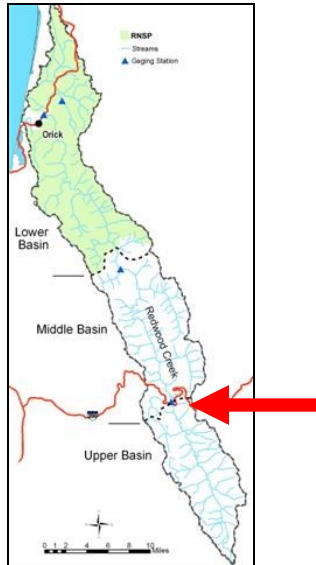


Max. Weekly Maximum Temperature: 7-day moving average of daily maximum temperature
The highest water temperatures fish exposed to - 7 consecutive days

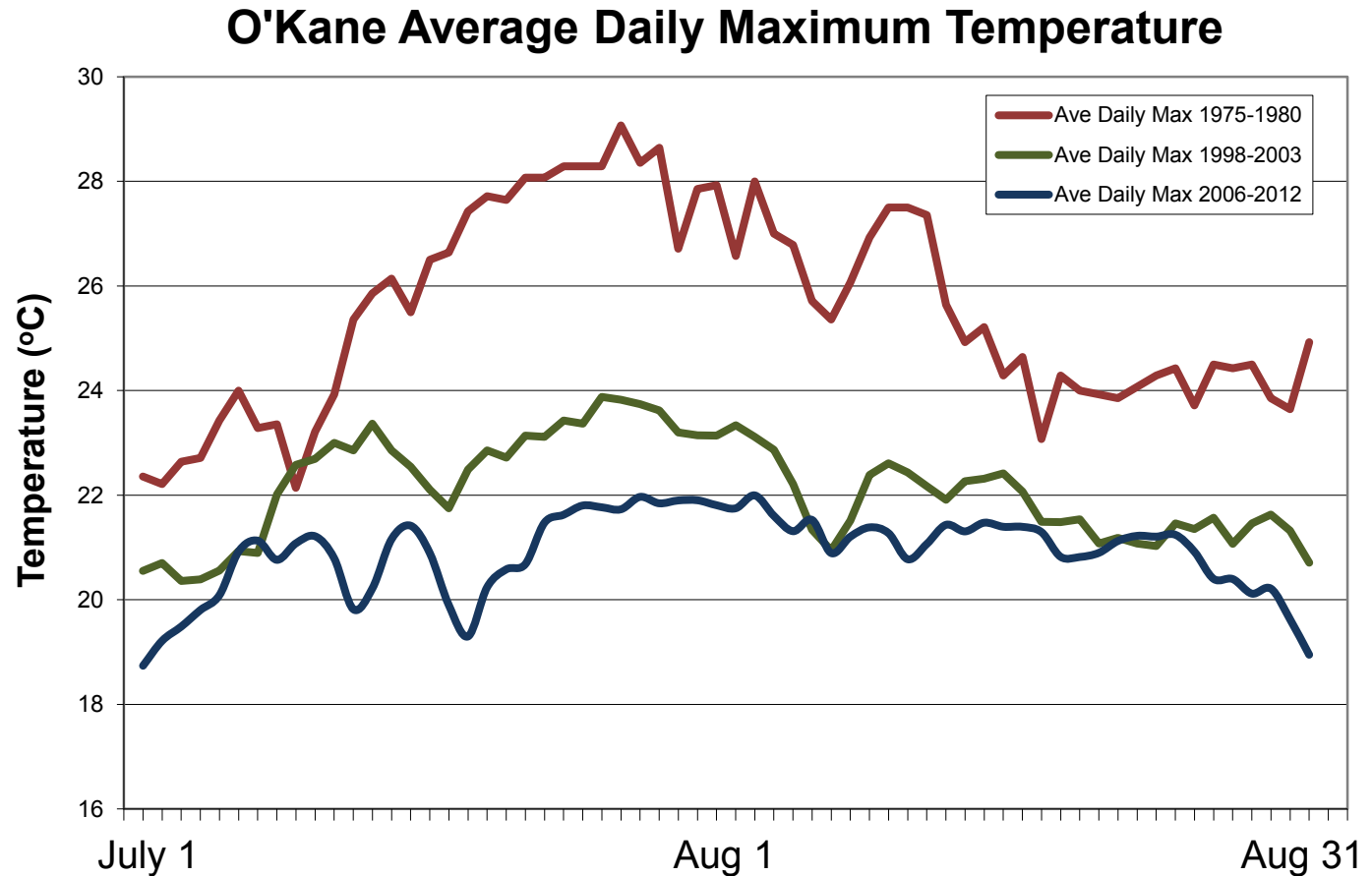
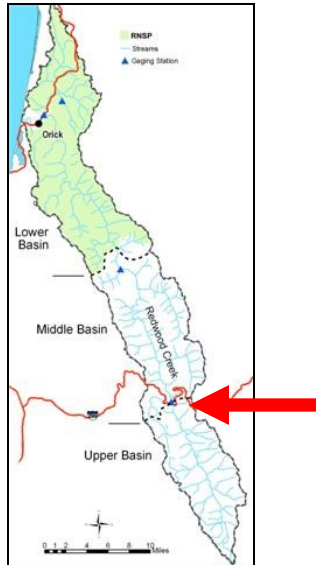
Maximum Weekly Maximum Temperatures (MWMT) Redwood Creek Tributaries



How has water temperatures changed over time?



How has water temperatures changed over time?



Fish Kill Observed at CDFW Trap in 2006, 2009, 2014



Mouth of Lacks Creek

1980

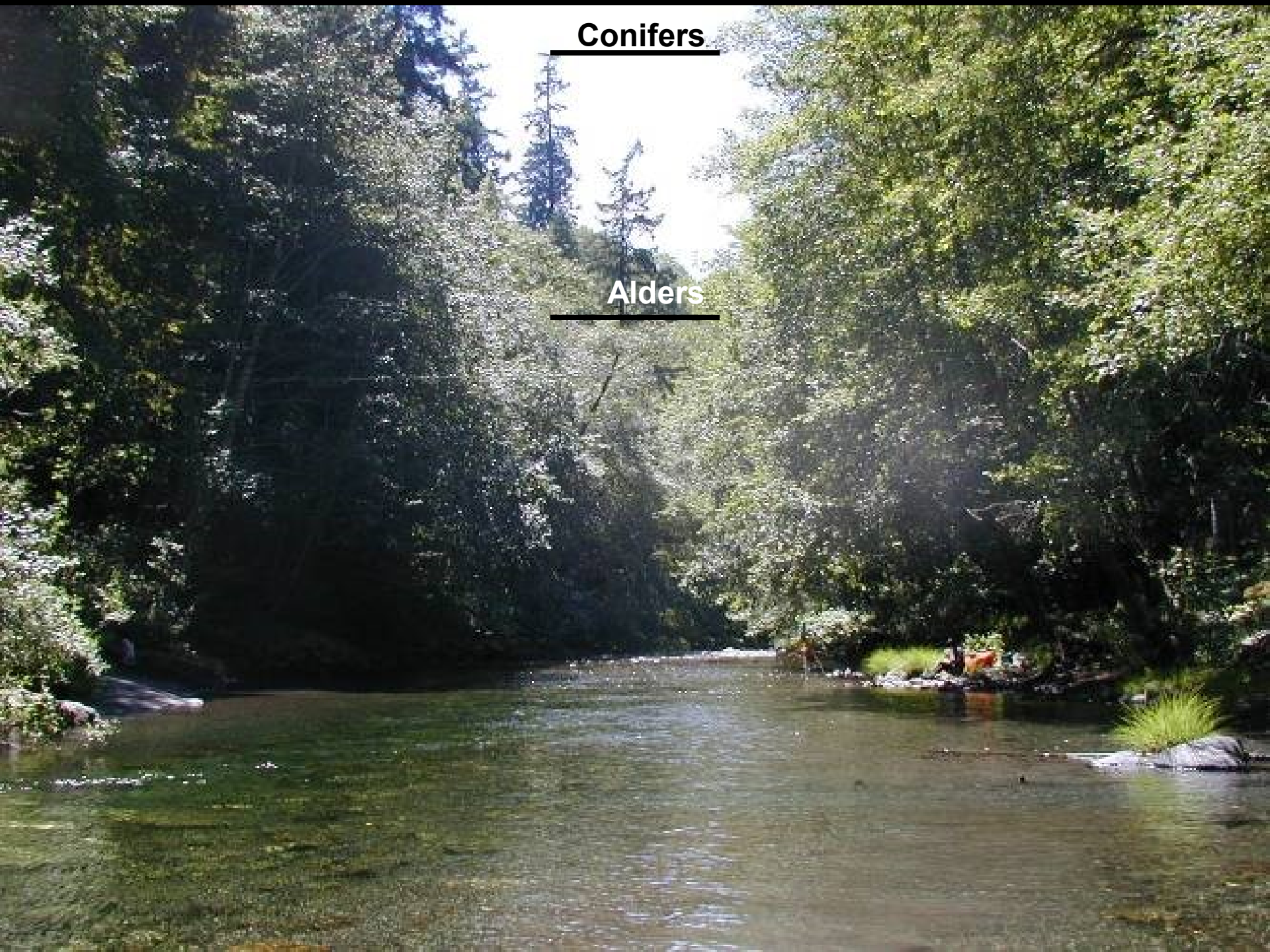


Mouth of Lacks Creek

2014

Conifers

Alders



Drought Impacts

REDWOOD CREEK DRY REACH

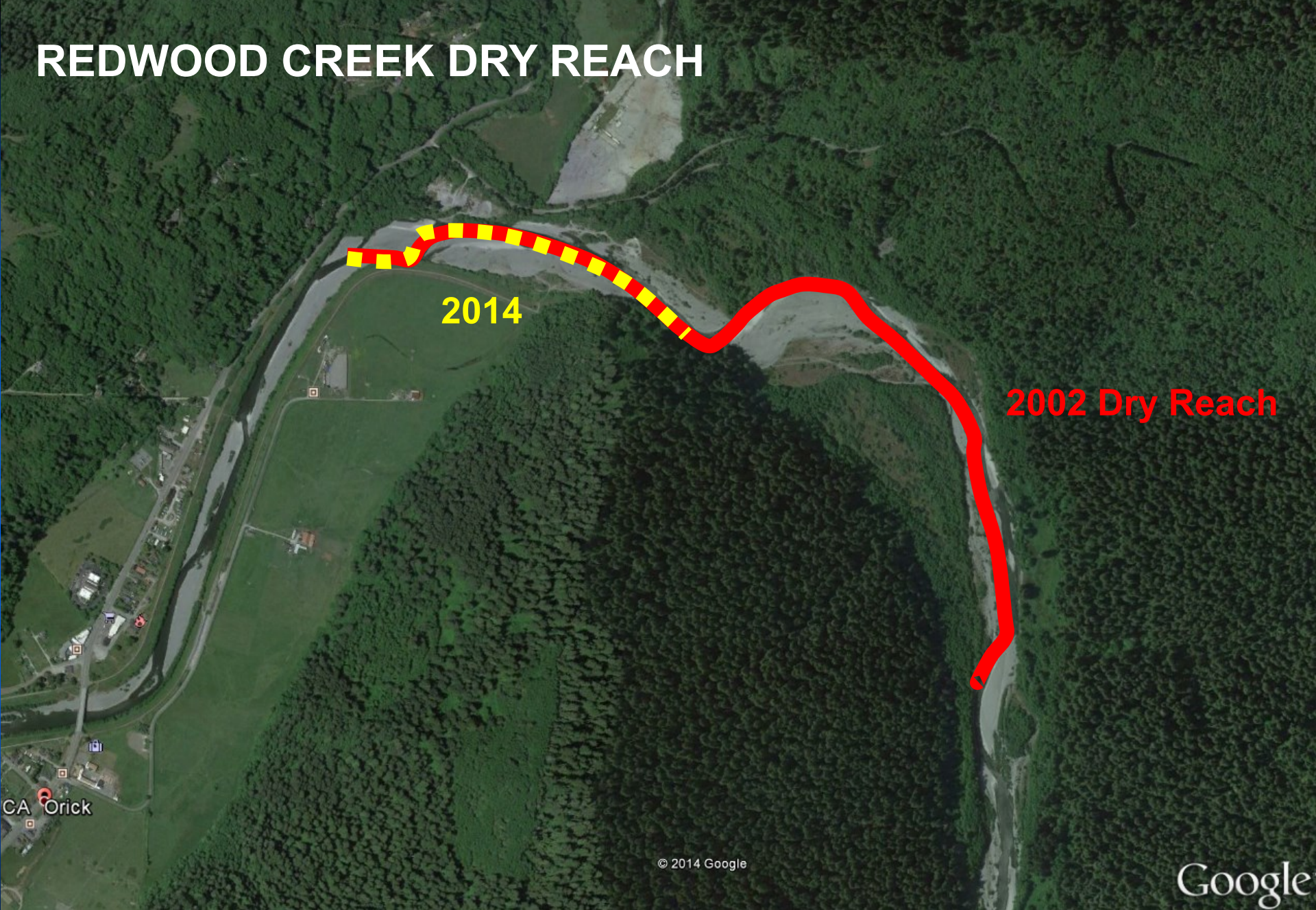
2014 Dry Reach

CA Orick

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REDWOOD CREEK DRY REACH



2014

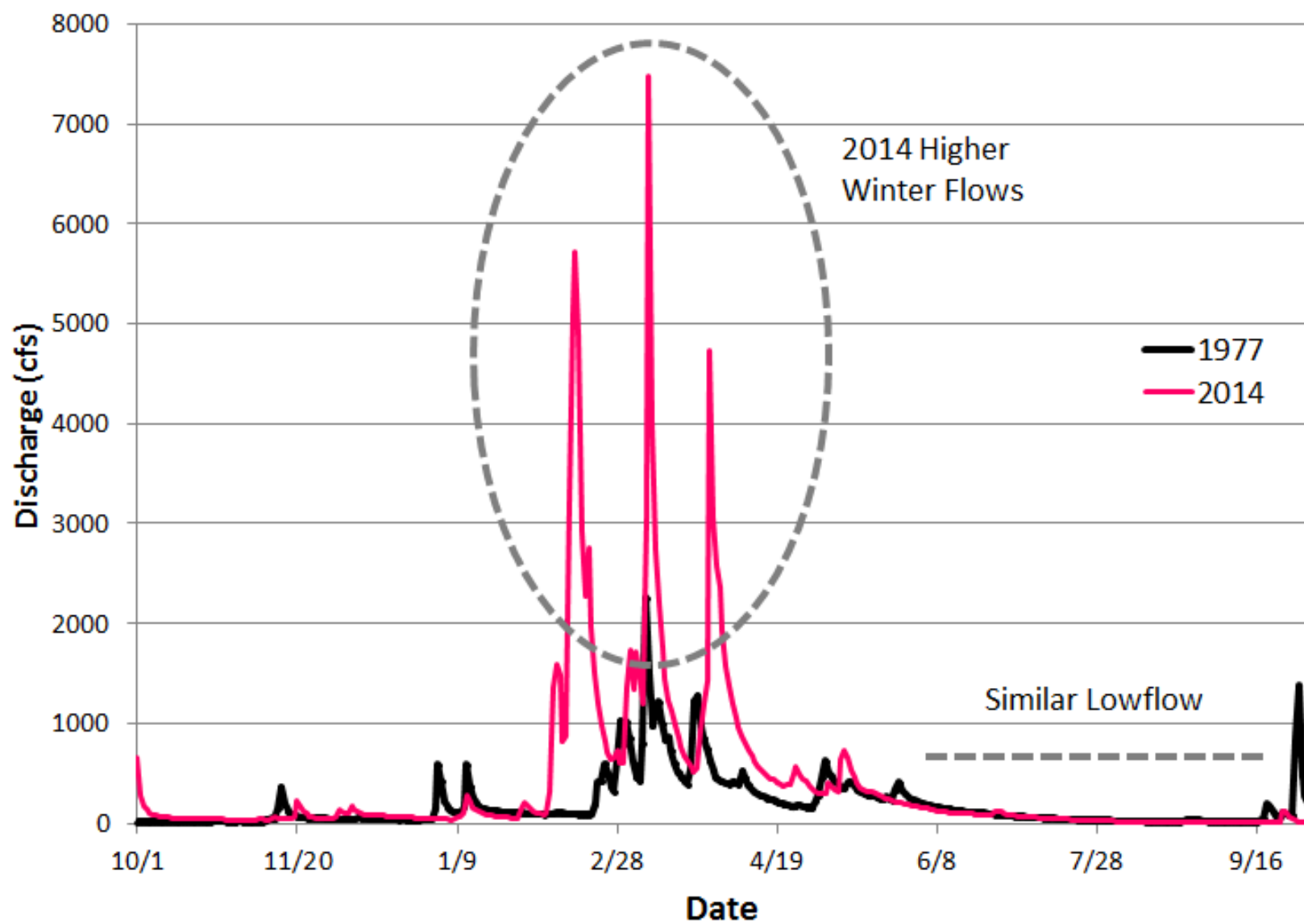
2002 Dry Reach

CA Orick

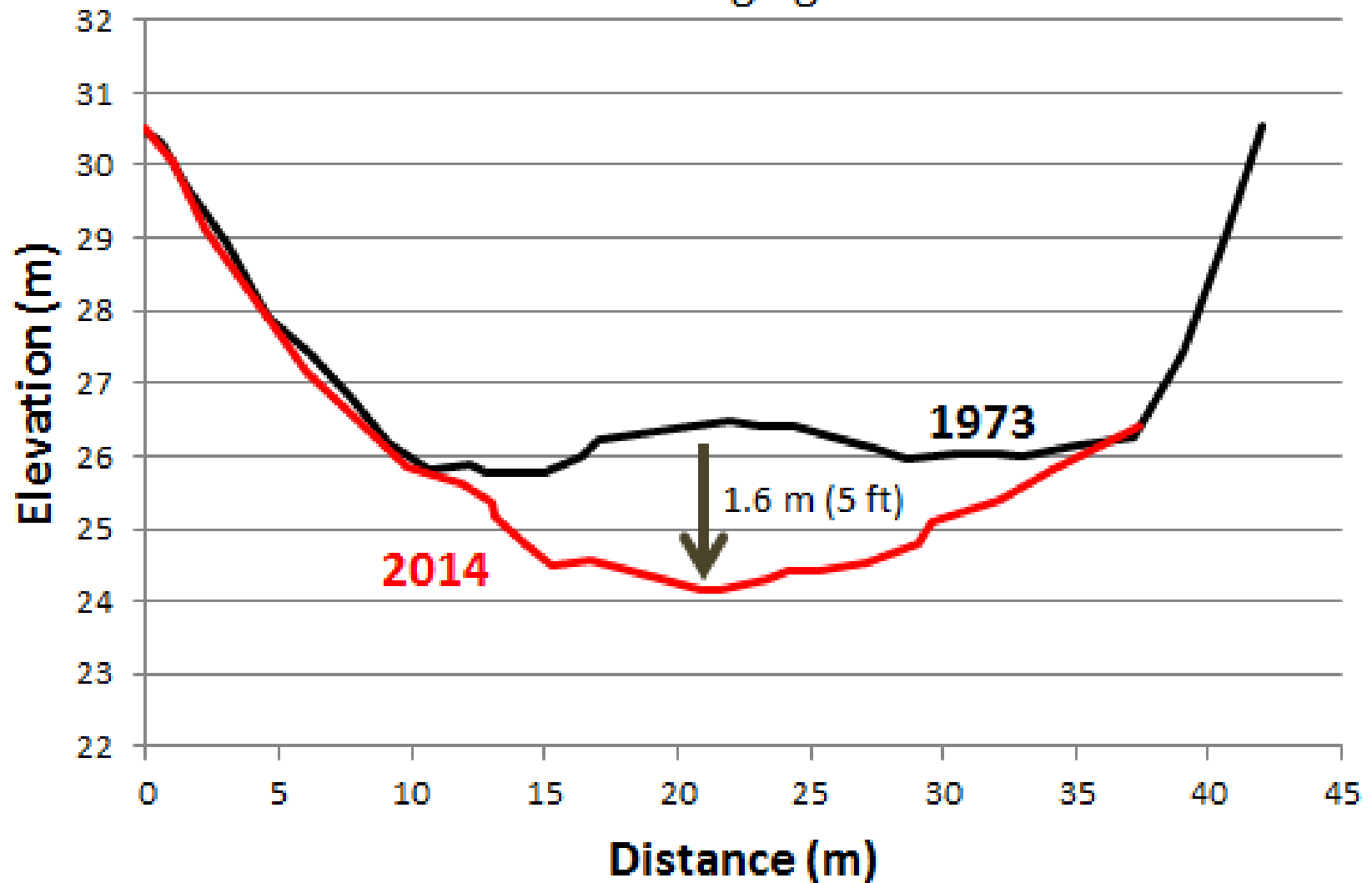
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Orick Mean Daily Flow



O'Kane Gaging Station



O'Kane Gaging Station

